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IS 11877 : 2019

स्वचल वाहन — स्वचल वाहन की अधिकतम गति — मूल्यांकन का तरीका

(पहला पुनरीक्षण)

Automotive Vehicles — Maximum Speed of Automotive Vehicles — Method of Evaluation

(First Revision)

ICS 43.020

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Automotive Braking Systems, Vehicle Testing and Performance Evaluation Sectional Committee, TED 04

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Automotive Braking and Steering System, Vehicle Testing and Performance Evaluation Sectional Committee had been approved by the Transport Engineering Division Council.

This standard was first published in 1986. While reviewing this standard the Committee responsible for the formulation of this standard has decided to revise the standard based on latest ECE regulations.

This standard is in-line with the ECE/TRANS/505/Rev.1/Add.67/Amendment 1.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

AUTOMOTIVE VEHICLES — MAXIMUM SPEED OF AUTOMOTIVE VEHICLES — METHOD OF EVALUATION

(First Revision)

1 SCOPE

This standard specifies the method for evaluation of maximum speed of an automotive vehicle of categories M_1 and N_1 as defined in IS 14272, including pure electric vehicles.

2 REFERENCES

The following standards contain provisions, which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards:

IS No.	*Title*
14272 : 2011	Automotive vehicles — Types — Terminology (*first revision*)

3 DEFINITIONS

For the purpose of this standard following definitions shall apply:

3.1 Approval of a Vehicle — Approval of a vehicle type as regard to measurement of the maximum speed indicated by the manufacturer.

3.2 Maximum Speed

3.2.1 *For Thermal Engine Driven Vehicles* — The maximum steady speed.

3.2.2 *For Electric Vehicles* — The highest average value of the speed, which the vehicle can maintain twice over a distance of 1 km.

3.3 Maximum 30 Min Speed for Electric Vehicles — The average value of the maximum speed, indicated by the manufacturer, which the vehicle can maintain for 30 min.

3.4 Type of Vehicle — Vehicles powered either by:

a) A thermal engine and which do not differ in such essential respects as, shape of the bodywork, engine, transmission, tyres and unladen mass of the vehicle; or

b) An electric motor(s) and which do not differ in such essential respects as, shape of the bodywork, electric drive train (motor(s) and controller(s)), traction battery (type, capacity, battery management), transmission (if any), tyres and unladen mass of the vehicle.

3.5 Unladen Mass — The mass of the vehicle in running order without occupants or load, but with the fuel tank full (if any), cooling liquid, service and traction batteries, oils, onboard charger, portable charger, tools and spare wheel, if provided in series by the manufacturer of the vehicle.

4 PREPARATION OF THE VEHICLE

4.1 Thermal Engine Driven Vehicles

4.1.1 The configuration of the vehicle and its attitude shall be as determined by the manufacturer. In addition, the vehicle shall be clean, the windows and air entries shall be closed and only the accessories necessary for the operation of the vehicle for the purposes of the test shall be in use. The settings of the fuel feed (carburettors or injection pumps) and ignition, the viscosity of the oils for the mechanical moving parts and the tyre pressures (for operation under full load at maximum speed) shall conform to the specifications of the vehicle manufacturer. The manually controlled reheater, if any, shall be set to the “summer” position unless otherwise specified by the manufacturer.

4.1.2 The running-in of the engine, transmission and tyres shall have been carried out in accordance with the manufacturer’s instructions.

4.1.3 The mass of the vehicle shall be its kerb mass plus 180 kg or plus half the full load if greater than 180 kg.

4.1.4 The fuel used shall be the commercial grade for the type of vehicle tested.

4.2 Electric Vehicles

4.2.1 Requirements of **4.1.1** shall be met, if applicable.

4.2.2 The charge of the traction battery shall be carried out with the on-board charger (if any) or with a portable charger, recommended by the vehicle manufacturer.

The procedure shall be according to a normal overnight charge, excluding all types of special charge, such as equalization or the servicing charge. The ambient temperature shall be between 20°C and 30°C.

The end of charge shall be specified by the vehicle manufacturer, but charging, expressed, in hours (h), shall not last longer than $\frac{C}{P}$

where,

C = Battery energy-capacity (Wh), as specified by the manufacturer, and

P = Mean power (W), drawn from the mains during charging.

4.2.3 All the energy storage systems available for use other than for propelling the vehicle (electric, hydraulic, pressure, etc.) must be charged according to the manufacturer's recommendations.

4.2.4 The vehicle shall have covered a distance of at least 300 km during a period of seven days preceding the test, using the batteries that will be installed in the vehicle for measuring the maximum speed.

4.2.5 The mass of the vehicle shall be its unladen mass plus half the full load in any case.

4.3 Characteristics of the Test Track

The measurement shall be effected on either a straight track in the conditions set out in **4.3.1** and/or a loop track in the conditions set out in **4.3.2**.

4.3.1 *Measurement on Straight Track*

4.3.1.1 *Surface condition*

The surface shall be hard, smooth and give good adhesion.

4.3.1.2 *Lengths*

4.3.1.2.1 The length L shall be selected in relation to the precision of the apparatus and the method used for measuring the time t of the run so that the actual speed can be determined within +/- 1 percent. For electric vehicles, the length of the measuring zone shall be at least 1 000 m. The length actually used for the measurement shall be recorded in the report.

4.3.1.2.2 *Stabilizing zone*

The stabilizing zone shall be of the same nature as the measuring zone, approximately straight, and of sufficient length for the speed of the vehicle to have stabilized at its maximum by the time the vehicle reaches the measuring zone.

4.3.1.3 *Slopes*

In the stabilizing and the measuring zones, the longitudinal slope shall not exceed 0.5 percent and the transverse slope shall not exceed 3 percent.

4.3.1.4 A section of loop track may be regarded as "straight" if the requirements of **4.3.1.1** to **4.3.1.3** are satisfied and the centrifugal inertia reaction is less than 20 percent of the initial weight of the vehicle and is compensated by the transverse slope of the track.

4.3.2 *Measurement on Loop Track*

4.3.2.1 *Surface conditions*

The surface shall be hard, smooth and give good adhesion.

4.3.2.2 *Length*

The length of the loop shall be not less than 2 000 m. For calculating the maximum speed, the length of run shall be the distance actually covered by the vehicle.

4.3.2.3 *Minimum radius of bends*

In plan, the loop track shall be a convex curve and may vary from a perfect circle to straight sections linked by approximately circular sections. The radius of curves shall be not less than 200 m. The effects of centrifugal force shall be compensated by the transverse profile of the curves in such a way that the vehicle holds a normal line without any action on the steering wheel.

4.3.2.4 *Correction factor for loop track*

A correction factor determined experimentally by the procedure given in Annex A may be applied for loop track. This correction factor shall be subject to confirmation by the administrative service at the time of approval by the technical service responsible for the tests. The factor may in no case entail a correction exceeding 5 percent. However, for vehicles equipped with a speed regulator, the factor shall not be applied if the regulator is in operation during the test.

4.4 Atmospheric Conditions

4.4.1 *Air Density*

The air density at the time of the test, calculated as set out below, shall not vary by more than 7.5 percent from the air density in the reference conditions.

The air density shall be calculated by the formula:

$$d_r = \frac{d_o}{H_o} \times \frac{H_T \times T_o}{T_T}$$

Where,

d_r = air density in the test conditions;

d_o = air density in the reference conditions;

H_T = pressure during the test; and

T_T = absolute temperature during the test (K).

Reference conditions:

Pressure: H_o = 1 000 mbar

Temperature: T_o = 293 K (20° C)

In addition, the atmospheric pressure during the tests shall be not less than 910 mbar and the temperature shall be not less than 278 K (5°C).

4.4.2 *Wind*

The average wind speed measured at a height of 1 m above the ground shall be less than 3 m/s, gusts shall be less than 5 m/s.

4.4.3 *Relative Humidity*

The relative humidity shall be less than 95 percent and the track shall be dry.

4.5 Test Method

4.5.1 *Warming-Up*

4.5.1.1 *Warming up for thermal engine driven vehicles*

Immediately before the test, the parts of vehicle which might affect the measurement shall be in the stable temperature conditions specified by the manufacturer. During measurement, the gear ratio used shall be that in which the vehicle is able to reach its maximum steady speed. The accelerator shall be fully depressed. Any coldstarting device or manual choke shall be out of operation.

4.5.1.2 *Warming up for electric vehicles*

After full charging carried out according to **4.2.2**, the vehicle shall be conditioned at a temperature ranging from 20°C to 30°C during a minimum period of two hours.

After the thermal conditioning and just before the beginning of the test, the vehicle shall be driven on a minimal distance of five kilometres, at a speed equivalent to 80 percent of the maximum 30 min speed as defined in **2.3**.

4.5.3 *Measurements at the Maximum Speed*

The distance covered and the time taken to cover, shall be determined with sufficient accuracy for the error in the maximum speed not to exceed 1 percent.

4.5.4 *Determination of Maximum Speed on a Straight Track*

4.5.4.1 *Two-direction test*

The time T_i taken to cover the measured length shall be measured. It shall be checked that the speed does not vary at any moment during the run by more than 2 percent. This procedure shall be effected not less than three times in each direction and the variation between the extreme values of the six "T_i" values recorded shall not exceed 3 percent.

For electric vehicles, the procedure shall be effected once in each direction.

A time T shall be determined by the formula:

$$T = \frac{1}{6} \cdot \sum_{1}^{6} T_i$$

The test speed shall be determined by the formula:

$$V = \frac{L \times 3.6}{T}$$

Where,

V = speed, in km/h;
T = time, in seconds; and
L = length of the measuring zone, in metres.

4.5.4.2 *Single-direction test*

Testing in one direction only shall be permissible if, in view of the characteristics of the circuit, it is not possible for the vehicle to reach its maximum speed in both directions. In this case:

a) The characteristics of the track shall be as set out in **4.3.1**, in addition, the variation in altitude shall not exceed 1 metre between any two points.
b) The run shall be repeated five times in immediate succession.
c) The axial wind component speed shall not exceed 2 m/s.
d) The maximum speed shall be determined by the following correction formula taking into account wind speed:

$$V_i = V_r \pm V_v \, . \, f$$

Where,

The + sign is used if the axial wind component is in the opposite direction to the vehicle, and the – sign if there is a following wind:

V_r = maximum speed, in km/h measured for each run;

$$V_r = \frac{3.6\,L}{T}$$

t = time in seconds taken to cover the measured length L (m);
V_v = axial wind component (km/h) = v × 3.6;
where v is the axial wind component measured in m/s; and
f = correction factor = 0.6.

Leaving aside the extreme values of V_i, the maximum speed V is given by:

$$V = \frac{1}{3} \cdot \sum_{1}^{3} V_i$$

4.5.5 *Determination of the Maximum Speed on Loop Track*

The time T_i required for a complete circuit shall be recorded. Not less than three measurements shall be made with the vehicle following a path corresponding approximately to that taken at the test speed, that is, not requiring any correction of course by action on the steering wheel. The difference between the extreme values measured shall not exceed 3 percent.

For electric vehicles, the distance covered shall not be less than 2 000 metres.

The time T shall be determined by the formula:

$$\overline{T} = \frac{1}{3} \cdot \sum_1^3 T_i$$

The apparent maximum speed shall be determined by the formula:

$$V_a = \frac{L \times 3.6}{T}$$

Where,

V_a = speed in km/h;
T = time in seconds; and
L = length of the path actually covered on the loop track, in metres.

The speed V_a shall then be corrected by an experimentally determined factor specific to the loop track used and taking into account, in particular, the effects of centrifugal force in the curves and the consequent changes in the attitude of the vehicle:

$$V = V_a \times k$$

Where,

$$1.00 < k < 1.05$$

Where, k is the correction factor determined in accordance with Annex C.

4.5.6 *Determination of the Maximum 30 Min Speed for Electric Vehicles on a Loop Track*

After preparation and warming up of the electric vehicle according to the requirements of **4.2.2** and **4.5.1.2**, the test shall be performed at a speed indicated by the vehicle manufacturer, which can be maintained over thirty minutes with a tolerance of ± 5 percent.

The distance L (km) covered shall be measured and the average speed (V) calculated as follows:

$$V = 2\ L\ (\text{km/h})$$

4.6 Interpretation of Results

The maximum speed indicated by the manufacturer for the type of vehicle, rounded to the nearest 1 km/h, shall be accepted if it does not differ by more than +/- 2 percent from the value measured by the technical service on the vehicle submitted for testing. If the difference is greater than +/- 2 percent the value taken shall be that found by the laboratory.

5 APPLICATION FOR APPROVAL

5.1 The declaration of maximum speed of the vehicle shall be submitted by its manufacturer or by his authorised representative in format as given in Annex B.

5.2 Guidelines for deciding of re-testing in case of modification made in already type approved vehicles are given in Annex C.

ANNEX A

(*Clause* 4.3.2.4)

PROCEDURE FOR DETERMINING THE CORRECTION FACTOR FOR LOOP TRACK

A-1 The correction factor k for loop track shall be determined up to the maximum permitted speed.

A-2 The factor shall be determined for several speeds in such a way that the difference between two consecutive speeds is not more than 30 km/h.

A-3 For each speed selected, the test shall be carried out in accordance with the requirements of this standard by both the possible methods.

A-3.1 Speed measured in a straight line, $V_{D.}$

A-3.2 Speed measured on loop track, $V_{A.}$

A-4 For each speed measured the values V_A and V_D shall be plotted on a diagram (Fig. 1) and each consecutive pair of points connected by a straight line.

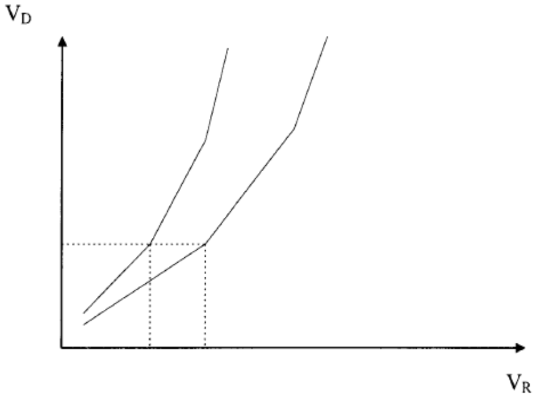

FIG. 1 CORRECTION FACTOR FOR LOOP TRACK

ANNEX B

(*Clause* 5.1)

B-1 INFORMATION TO BE SUBMITTED BY MANUFACTURER

B-1.1 Trade Name or Mark of the Motor Cycle: ..
....
....

B-1.2 Vehicle Type: ....
....
....

B-1.3 Manufacturer's Name and Address: ....
....
....

B-1.4 If Applicable, Name and Address of Manufacturer's Representative: ....
....
....

B-1.5 Brief Description of the Vehicle Type with Respect to Shape of Bodywork and Engine

B-1.5.1 *Gear Box Ratio Used*: ....
....
....

B-1.5.2 *Speed at 1,000 r.p.m. with the Ratio Used:* ......
....
....

B-1.5.3 *Unladen Mass of the Vehicle:* ....
....
....

B-1.5.4 *Maximum Speed as Approved*: ....
....
....

B-1.5.5 *For Thermal Engine Powered Vehicles (km/h):*
....
....

B-1.5.6 *For electric vehicles (km/h):* …………….............
....
....

B-1.5.7 *Maximum 30 min Speed (km/h)* :.......................
....
....

ANNEX C

(*Clause* 5.2)

GUIDELINES FOR DECIDING FOR TESTING IN CASE OF MODIFICATION MADE IN ALREADY TYPE APPROVED VEHICLE

Sl No. (1)	Modification Made in Vehicle (2)	Testing to be Done or Not (3)
i)	Engine type (*see* **3.4(a**), capacity, number and arrangement of cylinder	To be tested
ii)	Change in maximum power	To be tested, if the power is increased in excess of 5 percent
iii)	Change in maximum speed	To be tested if change in max speed is beyond tolerance of +/-2 percent of the measured value.
iv)	Type of transmission [*see* **3.4(b**)]	To be tested in case of any change.
v)	Tyre size	To be tested if size is increased/ decreased to change maximum speed value beyond +/- 2 percent.

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